17th international Mining Congress and Exhibition of Turkey- IMCET2001, ©2001, ISBN 395-417-4

Technique of No-Pillar Production and Repeated Development of Mineral Deposits with Ice-Rock Laying of Worked-Out Space

N.Zhalgassuly, M.T.Toktamysov, V.I.Galits, B.M.Mukushev & Z.U.Ergusaev
D.Â. Kunayev Institute of Mining, Ministry of Power, Industry and Trade. Almaty, Republic of Kazakhstan

ABSTRACT: This report describes the basic technique, technical opportunities and economic benefits of ice-rock laying of worked-out space in the process of no-pillar production and repeated development of mineral deposits, and also outlines areas for the efficient use of this technique.

1 INTRODUCTION

The aim of the technique is the extraction of useful minerals from seams, deposits or any ore body without leaving pillars of minerals and with complete or partial backfill of the worked-out space or with a structure of artificial pillars composed of ice materials, for example, ice rocks. The technique of *ice-rock* backfill or a structure of pillars is applied with repeated development of seams or ore bodies. Both natural and artificial cold obtained by various methods is applied to ice-rock stowing operations.

The application of ice for stowing is based on the following properties: at a pressure of more than 2 atm. (0.2 MPa), the ice passes from a fragile state to a state that is plastic and viscous. At an environmental temperature of more than 0°C, the temperature of a glacier constantly corresponds to the melting point of ice, 0°C. The melting of ice or freezing of water automatically maintains this state on the surface of the glacier. İt İs calculated that a glacier of 3-m thickness near a daylight area thaws in 300 years, and at a depth of 600 m thaws {due to the heat of adjoining rocks, engineering and ventilation) in 14.2 years.

By laying rocks on ice, and by using cooling agents (for example, solid carbonic acid) and heat insulation, it is sometimes possible to increase the safety of ice at any depth of mining operations.

Ice-rock backfill melts due to convection transfer of cold from the backfill: by thermal flows of massif of containing rocks, from the process apparatus and system of ventilation of wells and ore mines.

The average significant heat provided by adjoining rocks, without geothermal gradient, is 362 kcal/m^3 annually, which causes the melting of a 5-mm layer of ice on the surface of contact with adjacent strata.

As energy equal to 1 kW=3.6 M/ causes the melting of 10.75 kg of ice, the energy provided by the apparatus (5 kW/t) melts 53.75 kg or 0.06 m^3 of ice per ton of extracted ore, or 0.18-0.24 m of ice per 1 m of extracted ore.

Convection transfer of cold and melting of the backfill due to ventilation of the mine workings round the backfill are determined by known methods of heat mass transfer. The quantity of energy required for the formation of ice-rock backfill depends on the method of cooling agent reception, the method of obtaining the ice and the backfill technique, and İs within the range of 5-15 kWh per 1 t of extracted ore. As the cost of electrical power is 0.035 US dollars per kWh, the cost of backfill is 0.175-0.525 dollars/t of extracted ore, which İs much less than the cost of traditional backfill.

2 CONCLUSION

The benefits of this technique are reduction in cost of the stowing material and stowing works, and an increase in profit in mineral production of approximately 30 %. With the use of ice-rock backfill, there is the opportunity for the smooth lowering of overlying rocks in goaf on large areas under protected objects without significant damage. Thus, the ecological situation in wells, ore mines and on the surface is improved due to the use of ecologically pure stowing materials - water and cooling agents.

The technique can be applied with any mining methods which are now applied with goaf stowing with other materials and where the development of minerals is carried out under protected structures.